Q
11
.N524

short, no. 1
this for 9210

TRANSACTIONS
of
THE NEW YORK ACADEMY OF SCIENCES

SER. II, VOL. 9 DECEMBER, 1946 No. 2

SECTION OF GEOLOGY AND MINERALOGY

NOVEMBER 4, 1946

DOCTOR E. S. MOORE, University of Toronto, Toronto, Canada: *Origin of Iron Deposits of the "Lake Superior" Type.** (This lecture was illustrated by lantern slides.)

INTRODUCTION

The iron deposits which form the subject of this article constitute a peculiar type, presenting in their nature and origin some of the most puzzling problems in geology. They are peculiarly restricted, as far as is known, to the pre-Cambrian sequence, but they are widely distributed geographically, being found on all continents. The deposits on the various continents exhibit certain common features which make it impossible to distinguish between specimens obtained from these widely scattered areas.

Why should such deposits be confined to the pre-Cambrian and not reappear in later sequences? In the earlier days of geology, there was a tendency to invoke special physico-chemical and meteorological conditions in the pre-Cambrian era that have not existed since that time. To-day, however, we tend more and more to assume that geological processes and conditions have followed a series of rules well controlled by physical and chemical laws, through all the geological periods. It is rare, nowadays, that a geologist will seek to explain peculiar phe-

* By permission of the Provincial Geologist of Ontario.

TRANSACTIONS of The New York Academy of Sciences, Series II, Volume 9, No. 2, December, 1946.
This publication is distributed to Members and is published monthly from November to June, inclusive, at 109 West Chestnut Street, Lancaster, Pa., by The New York Academy of Sciences, Seventy-ninth Street and Central Park West, New York 24, N. Y.
Editor: Roy Waldo Miner.
Assistant Editor: Lothar Salin.
Executive Secretary: Eunice Thomas Miner.
Entered as second-class matter December 2, 1938, at the post office at Lancaster, Pa., under the act of August 24, 1912.

nomena on any other basis than these well-known laws. It may be necessary to assume peculiar combinations of circumstances and activities which produce conditions, every factor in which is not evident because of some missing item necessary for complete knowledge of the situation.

We have other great problems in geology that await solution. The causes of continental glaciation, and the accumulation of great quantities of petroleum in certain periods are two problems not yet fully solved. We believe that the solution will be found in the application of knowledge not beyond that of the modern scientist. It will be found in a special combination of conditions or activities, each one of which in itself may be fairly simple. The complexity of the combination appearing in one era may in some cases be so great that it does not reappear in other eras. It is thus, I believe, with these puzzling pre-Cambrian iron formations. The more we study the great complex known as the pre-Cambrian sequence, the more we are convinced that the geological processes of igneous activity, mountain building, erosion, and sedimentation during this earliest era were governed by the same laws as they were in the later eras. The main differences between the pre-Cambrian era and the later ones were in the relative amount of igneous activity and life, and the nature of the life which participated in geological processes.

Banded Iron Formation

The iron deposits which we are discussing are peculiar in being closely associated with a highly siliceous, well-banded formation, commonly known as "banded iron formation." The banding and the high silica content are the two prominent features, common to at least the greater part of all the formations, no matter where found. The silica may run from about 2 or 3 per cent in high grade ores found in some of the banded formations to about 99 per cent in the very siliceous types. The rock high in silica has more nearly perfect banding than that low in this substance. There may be practically nothing but magnetite or hematite with the silica, especially in the older systems like the Keewatin and Timiskaming. The iron oxides are in some cases fairly uniformly distributed through the silica, as they are in jasper, but in most of the formations they tend to be concentrated along darker bands.

There are, in some formations, in addition to hematite or mag-

Exch
New York Academy of Sciences
2-24-47

netite or both, other iron-bearing minerals, such as greenalite, a hydrous ferrous-magnesian silicate of green color, or chamosite, a similar member of the chlorite group, and siderite, hornblende, actinolite, and grünerite.

My experience has been that greenalite or chamosite are rare in the older iron formations, but abundant in the later ones such as those of the later Huronian, and the Animikie. The same is true of siderite, and I have found that, in a great many cases at least, this mineral has been introduced into the banded iron formations by hot waters.

Further, the silica in the older formations is cryptocrystalline to finely crystalline, even quite coarsely granular in some places, and not concretionary, as it is in many of the Proterozoic formations. The greenalite is also almost invariably found in öolites, and the hematite assumes öolitic form, due partly to derivation of some of it from öolitic greenalite and partly to direct precipitation in concretionary form.

The banding is most perfect in the older formations. This can be well observed in some places in the Lake Superior region where Keewatin and Animikie iron formations occur in the same locality, as on the Matawin Range. The Biwabik formation of the Mesabi Range is less well banded than the Soudan formation in the Vermilion Range, or scores of small Keewatin ranges in other parts of the Canadian Shield. The öolitic structure in the Biwabik formation is also well developed. I think that metamorphism had something to do with bringing out the banding, and where the iron content is high compared with the silica, the banding is less well developed. Where iron oxides are practically absent, the silica is often found in thicker bands.

The post-Cambrian sedimentary iron formations, such as the Clinton and Wabana of the Palaeozoic, and the Mesozoic minettes of France, are highly öolitic and lack the distinctive banding of the pre-Cambrian types. It would appear that the later pre-Cambrian formations were the precursors of those of the post-Cambrian. In view of the great role played by life in the formation of öolites of carbonate, one might well raise the question as to whether some form of life, such as iron bacteria or algae, for example, may not have begun in the late pre-Cambrian to play an important role in the deposition of the iron formations.[1]

Some of the banded iron formations contain no iron ore whatever. Others can be mined as ore which, it is believed, was laid down at the

time the silica-rich deposit was formed; that is, it is primary in character. Such ore is found in the Goulais River Range in Ontario, and in a number of other deposits. The material requires magnetic concentration, because the iron only runs, on the average, about 32 to 33 per cent. The remainder is almost entirely silica and, fortunately, the iron is almost all in magnetite. Some of the formation runs higher and some lower than these figures, but one of the striking features of the greater part of the formations is the remarkable uniformity in the grade of the ore. There is no evidence that there has been any appreciable concentration of iron by supergene or hydrothermal action since the formation was originally deposited.

In the Lake Superior region of the United States, on the other hand, and in those rich hematite deposits now being developed in eastern Quebec and in western Labrador, there is much evidence of supergene concentration of the ore. There are places in some of the iron formations where hematite appears to have been deposited in sufficient proportions to make primary low grade ore. I have seen such lenses on the Belcher Islands, Hudson Bay, and elsewhere, but all large ore bodies show evidence of extensive concentration of iron in the banded formations. Personally, I believe that these concentrations occurred mainly in pre-Cambrian time, at or near the surface where the formations were exposed to weathering before being buried by later formations, folded, and metamorphosed. Some of the ore bodies now lie at great depth. Gruner[2] has advocated concentration by hydrothermal action in the iron formations. The evidence from the Mesabi Range is particularly strong in favor of supergene concentration during pre-Cambrian and later periods.

There are large bodies of iron carbonate in the Michipicoten area of Ontario. They, too, are all associated with banded iron formation, and they present special problems of their own. They will be discussed later.

An impressive feature of the banded formations is the exceedingly intricate folding so often seen in them. Data for whole chapters on structures can be found in many small areas. The manner in which these hard brittle rocks which, in a given area, were complexly folded at one time and highly brecciated at another, raises questions regarding the physical condition of the material. I have come to the conclusion that the silica and iron were laid down in a colloidal state, and that before they were crystallized to a hard, brittle state they folded very

readily. Later, after becoming cryptocrystalline and brittle, they brecciated more readily than they folded.

Origin of the Banded Formation

It is very difficult to find a completely satisfactory explanation for the origin of these peculiar rocks and to elucidate why they are confined to the pre-Cambrian. A number of theories have been suggested, but none of them fully satisfies all requirements. The theories may be divided into two main classes, those based on igneous origin and those which consider the formations to be sedimentary. As in so many cases in geology, a combination of parts of two or more theories may help to explain exceptional conditions.

Van Hise and Leith offered a hypothesis based on igneous activity.[3] According to them, hot lava flows pouring into sea water set up a reaction between the lava and the water, producing sodium silicate of the nature of water glass, and iron chloride. The waters, on cooling, precipitated iron, silica, and hydrous iron silicate of the greenalite type. Laboratory experiments showed that such reactions could be demonstrated. When applied to field conditions, however, there are serious difficulties, because this explanation made necessary a repetition of many lava flows to build up a banded formation of considerable thickness, and such flows are rare or entirely absent in many of the iron ranges.

J. W. Gruner has, in several papers, supported the theory of weathering of land surfaces followed by deposition of iron and silica as chemical sediments. He puts up a very strong case for this idea. I have always strongly favored it, with some modification for some very siliceous formations in the Keewatin system. It seems probable that in highly volcanic areas considerable silica may have been supplied by hot springs and by waters heated by lava flows entering basins of water.

Lucien Cayeux, of Paris, has advocated the leaching of peneplained lands as the source of the iron in the French sedimentary iron deposits.

Dunn,[4] of India, has recently stated that he believes that some of the banded hematite in that country is of replacement origin. T. L. Tanton, of the Canada Geological Survey, has attempted to prove that the banded material was injected in hot solutions. There is, however, little evidence to support this notion, as no case was found of cross-

cutting relations between the banded silica and enclosing formations, such as would be expected to occur if deposition had been from hot solutions.

It is quite possible to have rocks as well banded as these by replacement of thinly bedded sediments. The fluorite deposits in Illinois and the lead and zinc ores in the Sullivan Mine in British Columbia are some examples. However, in Illinois, the country rock is a thin-bedded argillaceous limestone, and at the Sullivan Mine it is a thin-bedded argillite and the bands of ore reflect perfectly the original banding. No such thin-bedded rocks occur in most of the iron ranges to be replaced by the silica and iron and thus produce a pseudomorphous banded formation.

In recent years, I have been doing a lot of field work on these iron deposits and have collected some new data bearing on their origin. For example, in the Michipicoten district of Ontario, there are a number of siderite deposits closely associated with extensive formations of banded silica. The silica member in every range rests upon acid formations, mainly tuff and agglomerate with some rhyolite. The silica contains, in most places, practically no iron except some carbonate and sulphide which were unquestionably introduced long after the silica was deposited. In many other ranges, where the banded formation lies on basic rock, there is always much more iron with the silica member. I think this is strong evidence that the iron and silica were leached from the country rocks in the vicinity of bodies of water and deposited in them as chemical sediments.

I have always been a strong believer in the study of geochemical problems in the laboratory. This represents an immense field for investigation where one can imitate natural processes. It seemed to me that too little was known about the behavior of iron and silica under natural conditions, and I encouraged a graduate student, J. E. Maynard, now at Syracuse University, to work in the laboratory on these elements. He performed a great many careful experiments and we combined our field and laboratory data into a long paper.[5] Many interesting results bearing on the problems of the iron formations were obtained.

A number of rather surprising things were found. It was shown that iron, unlike calcium, is not carried as bicarbonate in natural surface solutions, but mainly as a ferric oxide hydrosol. The silica, up to 30 parts per million, is carried mainly in the colloidal state. Dr.

T. S. Lovering has recently expressed the opinion that some of the silica is ionized, and this seems quite possible. Colloidal silica and colloidal iron mutually precipitate one another, unless stabilized by an organic colloid. The influence of the stabilizing colloid loses its effect when electrolytes come in contact with these colloids.

It was found, further, that when the iron and silica entered water of the composition of sea water, the iron precipitates quite rapidly and the silica more slowly. Thus, a banded deposit may be built up by supplying colloidal solutions to a basin of salt water. It seems probable that these basins were sheltered bays on the oceans, inland seas, or salt lakes. Structures somewhat resembling the concretionary structures in some of the iron ranges were also developed.

From field and laboratory investigations, I strongly favor the sedimentary origin for most of the iron and silica. Laboratory experiments show that solutions of organic matter in which it is believed that CO_2 is the main active agent, or other solutions containing CO_2, are capable of producing sufficient colloidal iron and silica to make most of the banded iron formations. Further, there is enough iron and silica being carried by some streams today to make appreciable deposits. It seems probable that this large amount of finely comminuted rock, occurring as tuff in many of the iron regions, helped to supply much of the material. Also, the fresh vesicular lavas which break down readily under weathering conditions would supply the necessary substances. Woolnough[6] has recently stated that in Australia, where the duracrust is forming, conditions suitable for the collection of large quantities of iron and silica in salt water basins are found.

There remains the problem of how the organic colloid from peat solution to stabilize the colloids of iron and silica was supplied, way back in the pre-Cambrian. Personally, I believe that sufficient aquatic plants existed even in the early pre-Cambrian to do this. It takes only 9 parts per million of organic matter to stabilize 10 p.p.m. of ferric oxide hydrosol and 30 p.p.m. of colloidal silica, the average proportions which Gruner suggests exist in the iron ranges.

The Iron Carbonate Deposits

The siderite deposits of the Michipicoten district, Ontario, differ from all the others described, in that the siderite and associated pyrite are found with banded silica, while the ore was emplaced in a much later period than the banded silica. Further, the silica is almost free

from iron oxide in most places. It invariably lies on acid pyroclastics or flows.

Collins[7] assumed that the silica was deposited by hot springs and the siderite and pyrite beneath it, through replacement by rising thermal waters. Grout[8] very early pointed out the difficulty involved in this conception. Later, I observed some spacial relations among certain igneous intrusions, gold and sulphide deposits, and extensive carbonatization, which suggested that the siderite deposits were related to the same magmas as these other features. Hawley[9] showed that the pyrite and siderite had been introduced at a much later period than the silica. Recent mapping of the ranges in detail, by myself and Dr. H. S. Armstrong, for the Ontario Department of Mines, has shown that the siderite and associated pyrite were introduced after the banded silica was folded and in some places highly brecciated. The banded silica member of the iron formation always occurs in the hanging wall of the ore bodies. It exerted structural control in the emplacement of the siderite and pyrite which replaced, mainly, acid pyroclastics and some lavas. These minerals show a great preference for acid rocks in replacing the formations. Basic lavas stratigraphically above the banded silica are practically unaffected by the replacing solutions.

Why should so much carbonate ore be formed with the banded silica in Michipicoten, and so little in the other iron ranges? There is a peculiar situation here, in that there is an immense amount of ottrelite in the acidic rocks beneath the iron formation in that region. I have never seen anything comparable elsewhere in the Canadian Shield. There are also a great many dikes near the ore bodies, and some of them are full of ottrelite. Many dikes belong to the diorite family, some are kersantites, or mica diorites, and there are lamprophyres and other rocks of the intermediate type. There is granite in the offing, and it is believed that the ore bodies and dikes are of Algoman age and that they all came from a common magma.

Another strange feature is that at the Josephine Mine the ore is good red hematite, although it is in exactly the same position as the siderite in all the other ore bodies. It lies along the footwall of the banded silica, with carbonate to the east and west of it. The hematite is undoubtedly of hydrothermal origin and shows no definite evidence of having been formed by replacement of carbonate or alteration of it.

The explanation suggested to explain the presence of the hematite

in this carbonate zone is that the hematite and carbonate came from a common source; that considerable strike faulting occurred along the footwall of the banded silica member where the hematite is found; and that this was a factor in forming the hematite. There is, much later, transverse faulting in the carbonate deposits, but no evidence of strike faulting.

Around 500° C., the stability relations between siderite and hematite may be affected by changes in pressure. It is believed that with faulting occurring at the time when the ores were being deposited, there was a release of pressure in the zone where the hematite is found, and that this mineral was therefore deposited instead of siderite, with the minerals coming from the same magmatic source.

BIBLIOGRAPHY

1. **Moore, E. S.**
   1918. The iron-formation on Belcher Islands, Hudson Bay, with special reference to its origin and its associated algal limestones. J. Geol. **26**: 412–438.
2. **Gruner, J. W.**
   1926. The Soudan formation and a new suggestion as to the origin of the Vermilion iron ores. Econ. Geol. **21**: 629–644.
   1930. Hydrothermal oxidation and leaching experiments; their bearing on the origin of Lake Superior hematite-limonite ores. Econ. Geol. **25**: 697–719, 837–867.
   1932. Additional notes on secondary concentration of Lake Superior iron ores. Econ. Geol. **27**: 189–205.
3. **Van Hise, C. R., & C. K. Leith**
   1910. The geology of the Lake Superior region. U. S. G. S. Mon. **52**: 499–537.
4. **Dunn, J. A.**
   1941. The origin of banded hematite ores in India. Econ. Geol. **38**: 355–370.
5. **Moore, E. S., & J. E. Maynard**
   1929. The solution, transportation and deposition of iron and silica. Econ. Geol. **24**: 272–302, 365–402, 506–527.
6. **Woolnough, W. G.**
   1941. Origin of banded iron deposits—a suggestion. Econ. Geol. **36**: 465–489.
7. **Collins, W. H., T. T. Quirke, & Ellis Thomson**
   1926. The Michipicoten iron ranges. Can. Geol. Surv. Mem. **147**: 57–78.
8. **Grout, F. F.**
   1926. Michipicoten iron ranges (a review). Econ. Geol. **21**: 813.
9. **Hawley, J. E.**
   1942. Origin of some siderite, pyrite, and chert deposits, Michipicoten District, Ontario. Trans. Roy. Soc. Canada, Sec. **IV**: 79–87.

SECTION OF BIOLOGY

NOVEMBER 11, 1946

DOCTOR GEORGE H. CHAPMAN, Clinical Research Laboratory, New York, N. Y.: *The Staphylococci.** (This lecture was illustrated by lantern slides.)

The literature of staphylococci abounds with widely conflicting, vague and empirical statements. Technical methods, whose tremendous variations play a major role in the discrepancies, too often are changed at the whim of the investigator and are inadequately described. An attempt is made to analyze the basic principles involved in the isolation and testing of these organisms and to develop more reliable methods.

The taxonomy is in a chaotic state, because too much emphasis is placed on unstandardized biochemical and physiological properties which show marked differences with minor changes in technique. Investigators have proposed differentiation of species into *"aureus," "albus," "pyogenes," "saprophyticus,"* etc., and even a trinomial, *"Staphylococcus aureus hemolyticus,"* without regard to the fact that dissociation, which is extremely common in this genus, results, *e.g.*, in the presence of white variants in orange cultures and non-hemolytic variants in hemolytic cultures, often in the first subculture.

Staphylococci associated with inflammatory processes assume a number of biochemical, physiological, and pathogenic properties which are lacking in cultures from other sources or in old stock cultures. Hence, the differentiation should be into pathogenic and non-pathogenic strains. This association is far from absolute, because (1) lowered resistance of the host permits feeble parasites or even saprophytes to invade the tissues; (2) there are considerable differences in severity of the inflammatory lesions, usually with parallel differences in the properties of the cultures; and (3) the genus is so prevalent that it is a common contaminant: not only are pathogenic types common in non-pathogenic habitats but non-pathogenic types occur in pathogenic habitats. Because there is no precise definition of "pathogenicity," it is better to refer to an organism as the pathogenic, non-pathogenic, or intermediate "type."

Pathogenic types rapidly lose some of their properties on cultiva-

* Aided by grants from the Ophthalmological Foundation.

tion or storage, resulting in degenerate intermediates which may have positive, weakly positive, or negative reactions to any of the tests and, because not all the cells of a culture degenerate at the same rate or in the same manner, the cultures usually are kaleidoscopic mixtures of variants, each having different properties. The most degenerate types (saprophytes and G forms) usually react negatively to these properties. Certain reactions, *e.g.*, coagulase and α-hemolysin, are given by almost all pathogenic types but by extremely few non-pathogenic types and are used as *in vitro* indicators of pathogenicity. Other reactions are given by fewer pathogenic types and by more non-pathogenic types. They are unsuitable for this purpose.

Most pathogenic types have smaller cells (about 0.6μ, compared with 1.0μ in the non-pathogenic group); they produce orange growths which are hemolytic for rabbit, and sometimes other, erythrocytes; they are consistently gram-positive, whereas many saprophytes and G forms are gram-variable; they have strong reducing power; they are gelatinolytic, lipolytic, and fibrinolytic; they produce substances which clot plasma, are toxic for the skin, gastrointestinal tract, and conjunctivae, and kill laboratory animals; they produce a polysaccharide, agglutinins, and precipitins which are different from those of the non-pathogenic type; they produce more alkali in carbohydrate-free media than do the saprophytes; they produce a factor which increases tissue permeability; they resist the antibacterial power of fresh blood and lysozyme; they are more tolerant to sodium chloride; they clot milk; and they ferment dextrose, levulose, saccharose, glycerol, maltose, lactose, galactose, mannitol, d-mannose, and trehalose—but not dextrin, cellobiose, salicin, inulin, inositol, dulcitol, arabinose, xylose, raffinose, rhamnose, starch, mellibiose, adonitol, sorbitol, and melezitose. Non-pathogenic types have fewer of these properties.

Usual methods for isolation are hopelessly inadequate, particularly when other bacteria are present. "Blood agar" plates frequently are overgrown by other bacteria, and the hemolysis of horse and human blood so often used in its preparation has little significance. "Nutrient agar" is not selective and gives poor development of pigment. Attempts to find a selective isolation medium led to the development of alkaline bromthymol blue lactose agar, phenol red mannitol agar (Difco), alkaline bromthymol blue lactose agar with potassium tellurite and, finally, phenol red mannitol agar with 7.5 per cent sodium chloride. Because several writers complained of the amount of work

involved in isolating and testing staphylococci by the methods proposed, experiments were undertaken to try to develop a culture medium which would permit isolation on the basis of chromogenesis and at the same time provide easier application of coagulase and mannitol fermentation tests. Study of a number of ingredients showed that, for enhancing chromogenesis, mannitol was far superior to lactose but that a small amount of lactose gave more luxuriant growth and did not interfere with tests for fermentation of mannitol; Bacto yeast extract was decidedly better than meat extract and, with lactose, it overcame the inhibition of non-pathogenic types by sodium chloride; many peptones were unsuitable, Bacto tryptone (but not tryptose) being among the best; sodium chloride provided excellent inhibition of other bacteria and enhanced chromogenesis; and gelatin further improved chromogenesis and permitted direct application of the Stone reaction. Each ingredient was tested in several concentrations, and the optimum amount was selected. Conditions which improved chromogenesis also were more favorable for the coagulation of plasma.

The medium finally accepted (staphylococcus medium No. 110) made possible the selective isolation of staphylococci even when outnumbered 10 millions to 1 by other bacteria. It gave good pigment production, and the coagulase, mannitol fermentation, and Stone reactions could be applied directly to the original plates. It had the following composition: Water, 1,000 ml; agar, 15 grams; Bacto yeast extract, 2.5 grams; Bacto tryptone, 10 grams; mannitol, 10 grams; lactose, 2 grams; K_2HPO_4, Merck reagent, 5 grams; sodium chloride, 75 grams; gelatin, 30 grams. The following procedure is indicated: Adjust to pH 7.0 and sterilize in the autoclave. Incubate 42 to 43 hours for coagulase and 48 hours for the other tests. At 48 hours incubation, observe the color of the growth and select colonies for transplants. Place one drop of 0.04 per cent bromthymol blue on the cleared area left from the coagulase test. A yellow or greenish-yellow color indicates fermentation of mannitol. Add 10 ml. of ammonium sulfate solution that has been kept in the incubator with an excess of crystals (*i.e.*, supersaturated) and observe any clearing around the discrete pigmented colonies, which begins in about 5 minutes and is complete in about 30 minutes. Estimate the width of the clear zones as negative, weakly positive (about 1 mm.), and positive (2 to 4 mm.).

For the coagulase test, either apply the slide technique, which consists of emulsifying a colony in a drop of saline, adding a drop of

plasma, and observing almost immediate clumping, or apply the tube technique as follows: Incubate test strain No. 64 on staphylococcus medium No. 110 for 42 to 43 hours. For each blood sample, gather as much growth as possible into a 4 mm. loop and emulsify it in 0.1 ml. of Bacto brain heart infusion, which accelerates clotting, then let it stand exactly 15 minutes with frequent vigorous shaking. Add 0.2 ml. of the blood to be tested. Incubate and examine after 20 minutes. Select the samples that show a distinct but not necessarily firm clot. Most rabbit, but few human, samples are satisfactory. For the test, proceed similarly but use the culture to be tested and the selected blood, read the results in one hour and re-examine negatives in 5 hours, considering any definite evidence of clotting as positive.

These methods have proved to be valuable in the study of human and bovine infections, and in staphylococcus food poisoning. In the latter instances, staphylococci were readily found by us in large numbers, whereas another laboratory found none. By testing the nose and throat of food handlers and the feces of suspected victims, and comparing the reactions with those of staphylococci isolated from the peccant food, it is possible to trace the origin of the outbreaks, to establish that the victim has staphylococcus food poisoning and not another type of gastroenteritis, and to prevent outbreaks by eliminating carriers of food-poisoning staphylococci. Application of the Stone reaction by this direct method has verified the claim of Stone that the reaction is positive when applied to freshly isolated (pigmented) strains. In the series of outbreaks studied here, the reaction was positive in all incriminated staphylococci, and the strains from suspected handlers had identical properties and width of Stone zoning as cultures from the peccant food.

SECTION OF PSYCHOLOGY

NOVEMBER 18, 1946

DOCTOR J. MCVICKER HUNT, The Institute of Welfare Research, Community Service Society, New York, N. Y.: *Measuring Effects of Case Work on the Client.* (This lecture was illustrated by lantern slides.)

(An abstract of this paper will be published in the January issue of TRANSACTIONS.)

SECTION OF ANTHROPOLOGY

November 25, 1946

Doctor Karl A. Wittfogel, Columbia University, New York, N. Y.: *The Significance of Large-Scale Waterworks in the Higher Civilizations of Pre-Conquest America.*

(No abstract received.)

SECTION OF BIOLOGY

NOVEMBER 8, 1946

Conference on *"Bioluminescence."*

The Section of Biology held a Conference on "Bioluminescence." Doctor E. Newton Harvey, Princeton University, Princeton, N. J., was the Conference Chairman in charge of the meeting.

The program consisted of the following papers:

"A General Survey of Bioluminescence," by E. Newton Harvey, Princeton University, Princeton, N. J.

"Chemiluminescence in Aqueous Solution," by Rubert S. Anderson, University of Maryland Medical School, Baltimore, Maryland.

"Chemistry of *Cypridina* Luciferin," by Aurin M. Chase, Princeton University, Princeton, N. J.

"The Fundamental Action of Pressure Temperature and Drugs on Enzymes, as Revealed by Bacterial Luminescence," by Frank H. Johnson, Princeton University, Princeton, N. J., and Henry Eyring, University of Utah; Salt Lake City, Utah.

"The Microscopic Anatomy and Physiology of Light Production in the Firefly," by John B. Buck, National Institute of Health, Bethesda, Maryland.

NOVEMBER 15 AND 16, 1946

Conference on *"The Biology of Normal and Atypical Pigment Cell Growth."*

The Section of Biology held a Conference on "The Biology of Normal and Atypical Pigment Cell Growth." Doctor Myron Gordon, New York Zoological Society, New York, N. Y., was the Conference Chairman in charge of the meeting.

The program consisted of the following papers:

FRIDAY, NOVEMBER 15

Morning Session. Chairman, R. G. Harrison, Yale University, New Haven, Connecticut.

"The Melanoma Problem," by George T. Pack, Memorial Hospital, New York, N. Y.

"The Origin and Development of the Melanophores," by G. P. DuShane, Stanford University, Palo Alto, California.

"Pigment Cells in Man," by P. Masson, University of Montreal, Montreal, Canada.

"Dermatological Investigations of Melanin Pigmentation," by S. William Becker, University of Chicago School of Medicine, Chicago, Illinois.

"Relationship of Pigment Cell Clusters to Ocular Melanoma," by Helenor Campbell Wilder, The American Registry of Pathology, Army Medical Museum, Washington, D. C.

Afternoon Session. Chairman, W. E. Heston, National Cancer Institute, Bethesda, Maryland.

"Genetic Aspects of Pigment Cell Growth in Man," by Madge Macklin, University of Ohio, Columbus, Ohio.

"Growth and Vascular Reactions of Transplanted Mouse Melanomas," by Glenn H. Algire, National Cancer Institute, Bethesda, Maryland.

"Pigment Cell Tumors in Reptiles," by H. G. Schlumberger and Balduin Lucké, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania.

"The Cytology of the Typical and the Amelanotic Melanoma," by Michael Levine, Montefiore Hospital, New York, N. Y.

"Genetic Aspects of Normal and Atypical Pigment Cell Growth in Fishes," by Myron Gordon, New York Zoological Society, New York, N. Y.

SATURDAY, NOVEMBER 16

Morning Session. Chairman, V. C. Twitty, Stanford University, Palo Alto, California.

"Hormonal Influences on Pigmentation in Birds," by B. H. Willier, Johns Hopkins University, Baltimore, Maryland.

"Influence of the Endocrine Status upon Pigmentation in Man and in Mammals," by James B. Hamilton, Long Island College of Medicine, Brooklyn, N. Y.

"The Induction of Pigmented Tumors in Mice by Methylcholanthrene," by Leonell C. Strong, Yale University School of Medicine, New Haven, Connecticut.

"Effect of Various Factors on Transplantable Mouse Melanoma," by Kanematsu Sugiura, Memorial Hospital, New York, N. Y.

"Light and Melanin Pigment," by H. F. Blum, Guggenheim Fellow, Marine Biological Laboratory, Woods Hole, Massachusetts.

Afternoon Session. Chairman, Jesse P. Greenstein, National Cancer Institute, Bethesda, Maryland.

"Morphological Color Changes in Vertebrates," by Joseph M. Ordiorne, Georgetown University School of Medicine, Washington, D. C.

"A Classification of Melanins," by Howard S. Mason, National Institute of Health, Bethesda, Maryland.

"Some Features of Melanoid Biochromy in Animals," by Denis L. Fox, Scripps Institution of Oceanography, University of California, La Jolla, California.

"The Chemical Nature of Melanin," by F. H. J. Figge, University of Maryland School of Medicine, Baltimore, Maryland.

"Some Cytochemical Aspects of Pigment Cells," by M. J. Kopac, Washington Square College, New York University, New York, N. Y.

"Chemistry of Melanomas," by Jesse P. Greenstein, National Cancer Institute, Bethesda, Maryland.

"Physiological Genetics of Pigmentation in Mammals," by W. C. Russell, Elizabeth S. Russell, and Liane R. Braush, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

SECTION OF PHYSICS AND CHEMISTRY

NOVEMBER 29 AND 30, 1946

Conference on *"Chromatography."*

The Section of Physics and Chemistry held a Conference on "Chromatography." Doctor Harold G. Cassidy, Yale University, New Haven, Connecticut, was the Conference Chairman in charge of the meeting.

The program consisted of the following papers:

FRIDAY, NOVEMBER 29

"Introductory Remarks," by the Conference Chairman.

"The History, Scope, and Methods of Chromatography," by L. Zechmeister, California Institute of Technology, Pasadena, California.

"The Theory of Chromatography," by Henry C. Thomas, Yale University, New Haven, Connecticut.

"Chromatography by Optical Control of the Percolate," by Stig Claesson, Institute of Physical Chemistry, University of Uppsala, Sweden.

"Some Experiments in Systematic Quantitative Chromatography," by W. A. Schroeder, California Institute of Technology, Pasadena, California.

SATURDAY, NOVEMBER 30

"Fractionation and Analysis of Hydrocarbons by Adsorption," by Beveridge J. Mair, National Bureau of Standards, Washington, D. C.

"Stereochemistry and Chromatography," by L. Zechmeister, California Institute of Technology, Pasadena, California.

"Chromatography in the Streptomycin Problem," by Robert L. Peck, Merck and Company, Inc., Rahway, N. J.

"Partition Chromatography," by A. J. P. Martin, Messrs. Boots, Pure Drug Company, Ltd., Nottingham, England.

"Partition Chromatography of Amino Acids and Related Compounds," by Stanford Moore and William H. Stein, The Rockefeller Institute for Medical Research, New York, N. Y.

"Chromatography in the Isolation and Separation of the Various Penicillins," by Jacques L. Wachtel, Schenley Laboratories, Inc., Lawrenceburg, Indiana.

"Closing Remarks," by the Conference Chairman.

NEW MEMBERS

Elected November 21, 1946

SUSTAINING MEMBERSHIP

Daly, Sylvester, M.D., Bacteriology, Biochemistry. Instructor in Otolaryngology, College of Physicians and Surgeons, Columbia University; Attending Otolaryngologist, Presbyterian Hospital and Babies' Hospital, Columbia University, New York, N. Y.

Winsten, Walter Abbott, Ph.D., Biochemistry. Acting Laboratory Director, Antibiotics, Schenley Distillers Corporation, Larchmont, N. Y.

ACTIVE MEMBERSHIP

Abajian, John, Jr., M.D., Physiology. Associate Professor of Surgery (Anaesthesiology), University of Vermont College of Medicine, Burlington, Vt.

Bell, William Brown, M.A. President, American Cyanamid Company, New York, N. Y.

Bikerman, Jacob Joseph, Physical Chemistry. Merck and Company, Inc., Rahway, N. J.

Bonner, David, Ph.D., Microbiology, Genetics. Research Associate in Botany, Yale University, New Haven, Conn.

Bretnall, Pearl, Ph.D., Child Psychology. Assistant Professor, Department of Psychology, Brooklyn College, Brooklyn, N. Y.

Brown, M. Vertner, Ph.D., Physics and Biophysics. Instructor in Physics, College of the City of New York, New York, N. Y.

Clark, Mary C., B.S., Pharmacology, Bacteriology. Research Associate, Department of Pharmacology, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Collias, Nicholas E., Ph.D., Social Life of Animals, Ornithology. Instructor in Biology, Department of Biology, Amherst College, Amherst, Mass.

Cosgrove, Rachel, B.S. Research Associate in Pharmacology, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

de Suto-Nagy, G. I., Ph.D., Chemistry, Biology. Research Fellow, Sterling Chemistry Laboratory, Yale University, New Haven, Conn.

Eder, Howard Abram, M.D., Internal Medicine, Biochemistry. Assistant, and Assistant Resident Physician, Hospital of the Rockefeller Institute, New York, N. Y.

Freedman, Alfred M., M.D., Pathology, Physiology. Assistant, Department of Pathology, Mount Sinai Hospital, New York, N. Y.

Gabrilove, Jacques L., M.D., Biochemistry, Clinical Investigation. Blumenthal Fellow, The Mount Sinai Hospital, New York, N. Y.

Goldring, William, M.D. Associate Professor of Medicine, New York University, Medical College, New York, N. Y.

Gorbman, Aubrey, Ph.D., Biology, Endocrinology. Assistant Professor, Zoology, Barnard College, New York, N. Y.

Groupe, Vincent, Ph.D., Microbiology. Senior Research Associate, Squibb Institute, Princeton, N. J.

Grumbach, Leonard, Ph.D., Physiology, Pharmacology. Instructor in Pharmacology, College of Dentistry, New York University, New York, N. Y.

Healy, Adelaide, A.B., Anthropology, Psychology. President, American Association of University Women, Garden City Branch, New York, N. Y.

Hine, Carolyn Hall, B.S., Pharmacology. Pharmacology Research Assistant, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Hope, Fred J., B.S., Organic Chemistry. Research Chemist, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Johnstone, Donald B., M.S., Microbiology. Research Fellow, Rutgers University, New Brunswick, N. J.

Koffler, Anna H., Ph.D., Bacteriology, Immunology, Serology. Research Assistant, Bacteriological Development Department, E. R. Squibb and Sons, New Brunswick, N. J.

Lapan, Bernard, M.D., Gynecology and Obstetrics, Pathology, Endocrinology. Junior Adjunct, Obstetrics and Gynecology, and Volunteer Assistant in Pathology, Lebanon Hospital, New York, N. Y.

Larson, Nora L., M.S. Research Bacteriologist, Takamine Laboratory, Inc., Clifton, N. J.

Lehmann, Gerhard, Ph.D. Pharmacologist, Hoffmann-LaRoche, Inc., Nutley, N. J.

Mangieri, Carmen N., B.S. Head, Department of Pharmacological Control, Hoffmann-LaRoche, Inc., Nutley, N. J.

Meaney, Margaret Ann, B.A., Biochemistry. Pharmacology Research, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Merck, George W. President, Merck and Company, Inc., Rahway, N. J.

Molomut, Norman, Ph.D., Bacteriology, Physiology, Biochemistry. Associate Director, Biological Laboratories, Brooklyn, N. Y.

Newell, Thomas W., A.B., Chemistry. Member of Commercial Development Division, Merck and Company, Inc., Rahway, N. J.

Novack, Lazare, Ph.D., Organic Chemistry, Biochemistry, Pharmacology. Research Fellow, Faculty of Medicine, New York University, New York, N. Y.

Port, William S., M.S., Organic Chemistry. Research Chemist, Heyden Chemical Corporation, Garfield, N. J.

Prier, James E., D.V.M., Veterinary Science. Veterinary Bacteriologist, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Ross, O. A., Ph.D., Bacteriological and Biochemical Research. Research Biologist, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Rubinstein, Michael A., Ph.D. Research Assistant in Hematology, Mount Sinai Hospital; Adjunct Attending Physician for Hematology, Montefiore Hospital; Instructor in Hematology, Post-graduate Courses, Columbia University, New York, N. Y.

Samuels, Leo T., Ph.D., Endocrinology, Metabolism. Head, Department of Biochemistry, University of Utah Medical School, Salt Lake City, Utah.

Seegal, Beatrice Carrier, M.D. Associate Professor of Bacteriology, College of Physicians and Surgeons, Columbia University, New York, N. Y.

Sichel, F. J., Ph.D. Professor of Physiology, University of Vermont College of Medicine, Burlington, Vt.

Smith, Carl H., M.D., Hematology. Assistant Professor of Clinical Pediatrics, Cornell University Medical College, New York, N. Y.

Sosman, Robert B., Ph.D., Chemistry, Geology, Physics. Physicist and Assistant Director, Research Laboratories, United States Steel Corporation, Westfield, N. J.

Starr, Mortimer Paul, Ph.D., Bacteriology, Biochemistry, Plant Pathology. Assistant Professor of Biology (Bacteriology), Department of Biology, Brooklyn College, Brooklyn, N. Y.

Tager, Morris, M.D., Bacteriology, Medicine. Assistant Professor of Bacteriology, Yale University Medical School, New Haven, Conn.

Tamerin, Joseph A., M.D. Associate Surgeon in Charge of Plastic Surgery, Harlem Hospital, New York, N. Y.

Wagley, Charles W., Ph.D. Assistant Professor of Anthropology, Columbia University, New York, N. Y.

Watson, R. Janet, M.D., Hematology. Instructor of Medicine, Long Island College of Medicine, Brooklyn, N. Y.

Weintraub, Solomon, M.D., Pathology. Director of Laboratories, Harlem Hospital, New York, N. Y.
Wendt, Arthur S., Ph.D. Chief Chemist, Fred Fear and Company, Brooklyn, N. Y.
Woodcock, Alfred H. Research Associate in Oceanography, Woods Hole Oceanographic Institute, Woods Hole, Mass.

ASSOCIATE MEMBERSHIP

Caldwell, Mary L., B.S., Microchemistry. Research Assistant, Research Laboratory, General Electric Company, Schenectady, N. Y.
Francis, William J., Jr., B.Sc., Meteorology and Oceanography. U. S. Navy, Aerological Officer, Naval Air Station, Lakehurst, N. J.
Gall, Lorraine Sibley, Ph.D., Bacteriology, Nutrition. Research Fellow, Nutrition Laboratory, Yale University, New Haven, Conn.
Gordon, William E., M.S., Microwave Radio Propagation, Meteorology. Chief Meteorologist, Electrical Engineering Research Laboratory, University of Texas, Austin, Texas.
Peck, Harold M., M.D., Medical Research, Pharmacology. Research Associate, Department of Pharmacology, Sharp and Dohme, Inc., Glenolden, Pa.
Strauss, Ulrich Paul, Ph.D., Physical Chemistry of High Polymers. Research Fellow, Department of Chemistry, Yale University, New Haven, Conn.
Wexler, Raymond, M.S., Meteorology. Meteorological Physicist, Evans Signal Laboratory, Belmar, N. J.
Wiselogle, Frederick Y., Sc.D., Organic Chemistry. Squibb Institute for Medical Research, New Brunswick, N. J.

STUDENT MEMBERSHIP

Vogel, Herbert, B.S., Psychology. Student, New York University Graduate School, New York, N. Y.
Weiss, Sidney, M.S., Chemistry. Student, Fordham University, New York, N. Y.